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Centennial
Minerals, inc.
(Helena, Mont.)
Description of
the plan of
operation, Montana
Tunnels Project,

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DESCRIPTION OF THE PLAN OF OPERATIONS

MONTANA TUNNELS PROJECT

JEFFERSON COUNTY, MONTANA

Centennial Minerals Ltd

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DESCRIPTION OF THE PLAN OF OPERATION
MONTANA TUNNELS PROJECT
JEFFERSON COUNTY, MONTANA

for

Montana Department of State Lands
1625 Eleventh Avenue
Helena, Montana 59620

by

Centennial Minerals Inc.
4th Floor, Power Block Building
6th & Last Chance Gulch
Helena, Montana 59601

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May 9, 1984

Revised May 24, 1984, to include federal land status

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EXECUTIVE SUMMARY

Centennial Minerals Limited in partnership with the United States Minerals Exploration Company (U.S.M.X.), of Denver, Colorado, desires to develop a gold, silver, lead and zinc open pit mine and ore processing operation at the Montana Tunnels property in Jefferson County, Montana. Centennial Minerals Incorporated, a wholly owned subsidiary of Centennial Minerals Limited, will be the operator of the mining and ore processing facility.

During the design, development and operation of this project, the Company wishes to ensure that all aspects of the operating permit process are fully completed in coordination with the State of Montana. All mining and ore processing operations will be managed in full compliance with all local, state and federal laws, regulations and requirements. It is the Company's intention to prevent or minimize any adverse effects on the environment and to maximize the beneficial effects of this project.

In an atmosphere of open communication and full disclosure of the Company's plans and intentions, Centennial believes an excellent facility can be built and operated and make a significant, beneficial contribution to the State of Montana and to Jefferson County. Input and assistance from all interested parties would be most welcome to facilitate a constructive approach to the design and operation of a facility such that all involved can be justly proud. To better foster

ongoing communication with all interested parties, Centennial will be opening an office in Helena in May 1984.

Centennial proposes to develop an open pit mine producing 15,000 tons of ore per day (5,250,000 tons per year). The ore will be processed through a crushing, grinding, flotation and precious metals recovery facility. Gold-silver dore bullion will be produced in addition to zinc and lead concentrates. Capital cost of the facility is expected to approach 85 million dollars with an annual operating cost of between 35 and 40 million dollars. During the construction phase, up to 350 people may be employed. Following construction, the operating work force is expected to average 200 to 300 people with an annual payroll of 10 million dollars.

It is Centennial's intention to employ, whenever possible, people from Montana in all phases of the project development and operation. Presently, Montana companies such as Hydrometrics, Bison Engineering and Mountain International of Helena are involved in the project. In addition, the drilling contractor, Airo Drilling of Kalispell, and the assay facilities of Bonder Clegg in Missoula are being utilized.

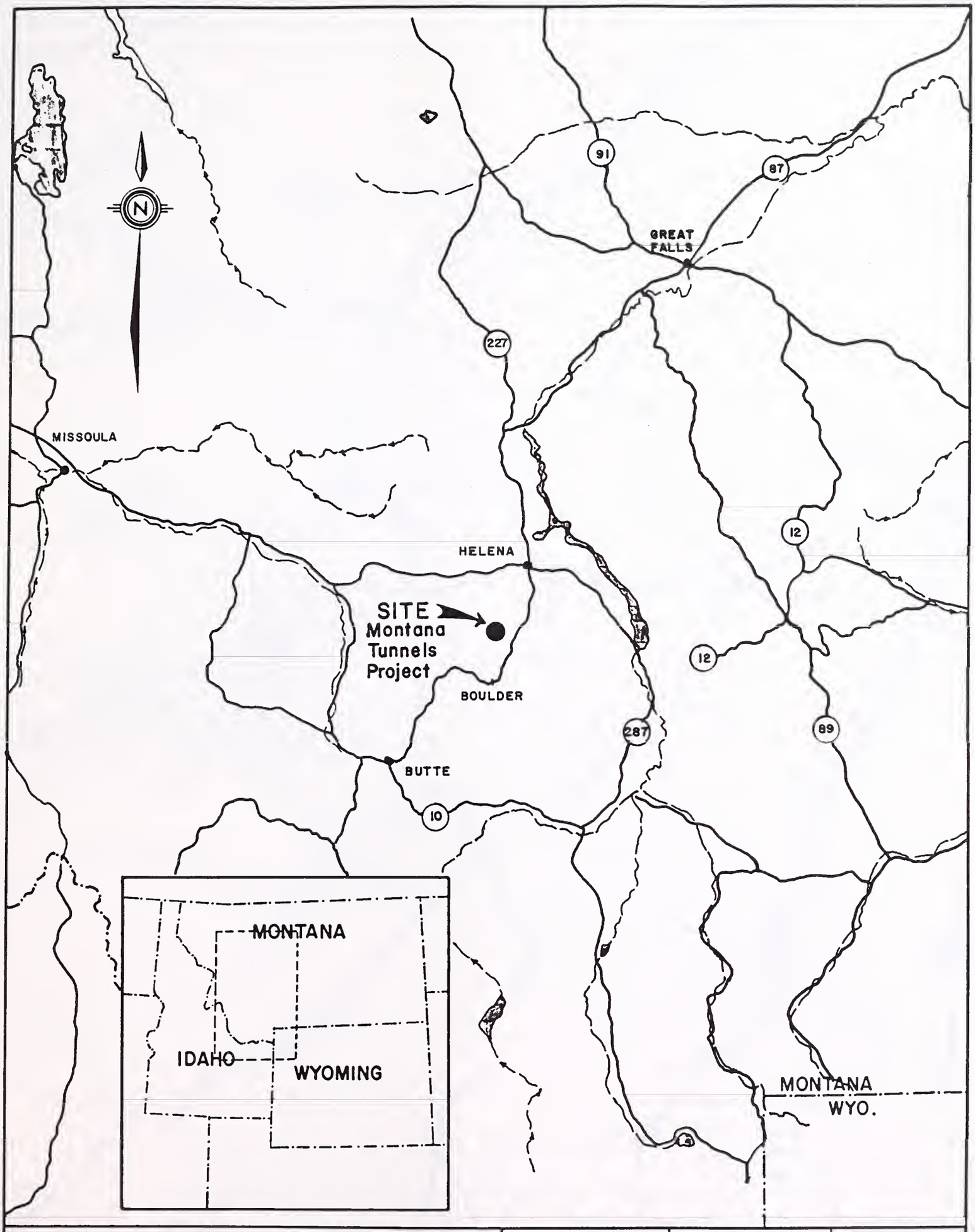
1. LOCATION

The property is located in Jefferson County, Montana, approximately 17 miles north of Boulder, the County seat, and 25 miles south of Helena, the State Capital. Geographic coordinates of the center of the property are 45° 22' N, 112° 08' W (Sections 4, 5, 7, 8 and 9, Range 4W, Township 7N) (Figure 1).

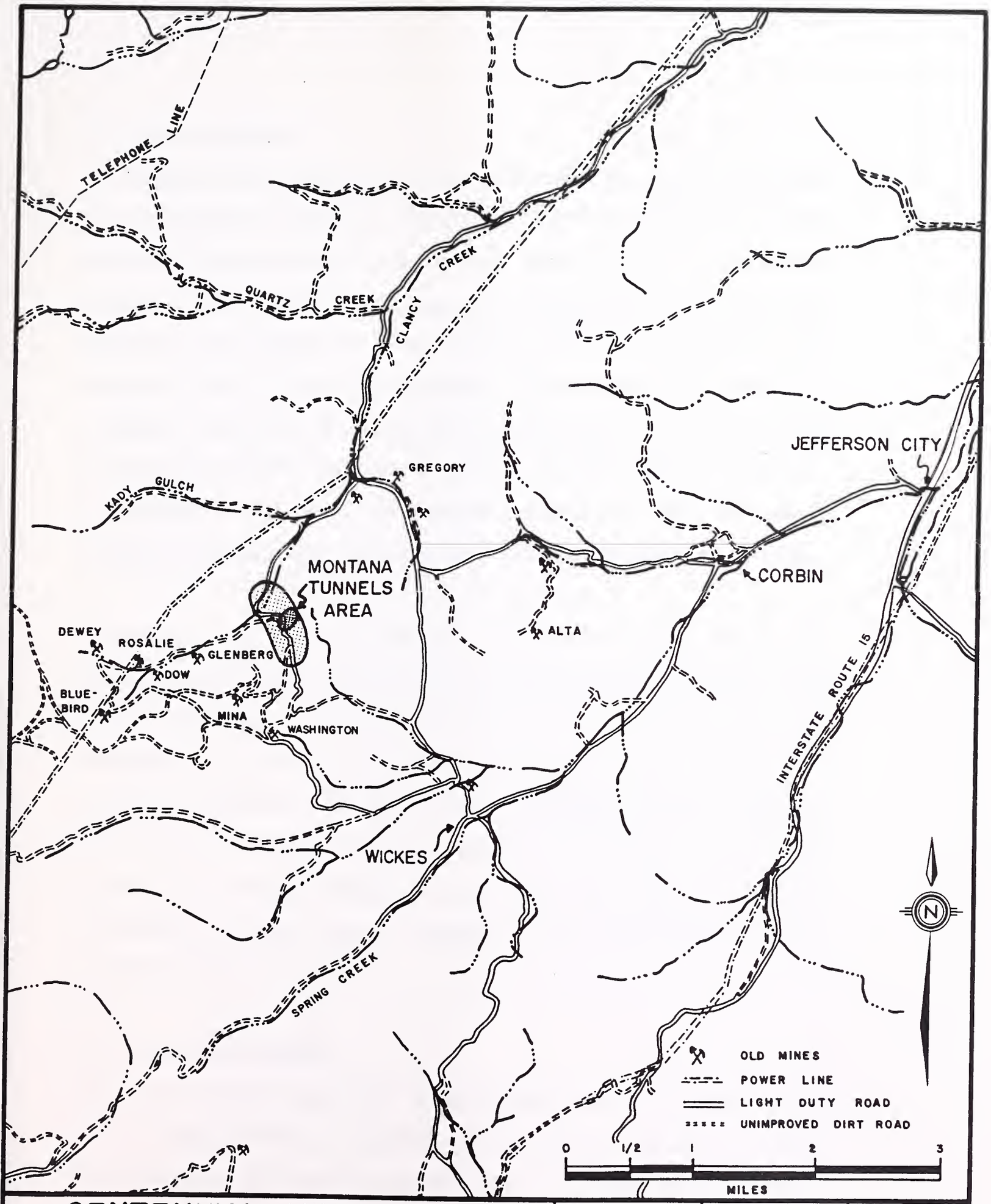
2. PREVIOUS MINING ACTIVITY

Following the discovery of placer gold in the general vicinity of the Montana Tunnels property in 1864, the area has experienced intensive mining. The Montana Tunnels property land assemblage contains at least seven old mines and developed mineral showings. An additional 10 to 15 mines are present in the local area. Mines within the project area include the Alta, a large underground mine and associated open pit most recently worked in the 1950's and the Gregory, worked from 1867 to 1889. Other significant mines include the Dewey, Rosalie, Dow, Glenberg and the old Montana Tunnels (Figure 2).

As a result of previous mining activity, the area is very disturbed and has numerous old waste and tailings dumps. Remains of an old smelter can be seen south of the property near the small community of Wickes. Clancy Creek to the north of the property has been dredged for placer gold and is disturbed downstream to the community of Clancy.



CENTENNIAL MINERALS LTD. MONTANA TUNNELS PROJECT LOCATION MAP	DRAWN BY: 00409848BDINGCOL	NTS	FIGURE NO.
	DESIGNED BY:	SCALE: 1" = 26 mi. (Approx.)	1
	APPROVED BY:	DATE APRIL 1984	
	REVISION		



CENTENNIAL MINERALS LTD.

MONTANA TUNNELS PROJECT
LOCATION MAP

DRAWN BY: S.McCURDY	NTS	FIGURE NO.
DESIGNED BY:	SCALE: AS SHOWN	2
APPROVED BY:	DATE: APRIL, 1984	
REVISION		

3. DEPOSIT GEOLOGY

The general area includes various volcanic deposits of late Cretaceous and Oligocene age known as the Elkhorn Mountain Volcanics and the Lowland Creek Volcanics. The Montana Tunnels orebody is contained within a large volcanic neck emplaced at the contact zone these two volcanic rock formations. The volcanic neck can be likened to the Mount St. Helens volcano in Washington. This volcanic neck, known as a diatreme, was forced up through the overlying rocks in a violent manner with frequent massive explosions caused by the hot magma encountering groundwater. As a result, the diatreme consists of rounded and angular volcanic fragments with a texture resembling poorly cemented concrete.

Fracturing occurs in the diatreme. Sulfides of lead (galena), iron (pyrite), zinc (sphalerite) and minor copper (chalcopyrite) occur along these fractures. Gold and silver occur as native metals, but more frequently are present as electrum (gold and silver combined) in intimate association with the sulfides. Although sulfide mineralization occurs throughout the diatreme, it is the center portion that contains the economic concentrations of precious metals. Available information does not show the presence of any significant mercury or arsenic minerals in the ore.

4. PRODUCTION ECONOMICS

The grades of gold and silver in the Montana Tunnels ore body are very low; however, studies of operating costs and metal recoveries indicate that with current precious metal prices, a large and efficiently

managed operation will be profitable. Recovery of zinc and lead assist in the economics of the operation. Preliminary production forecasts indicate the mine, operating at 15,000 tons per day would have a life of approximately 15 years.

5. MINING OPERATION

The mine will be developed as a conventional open pit with a final depth of about 600 feet below the ground surface. During the pit life, it is expected that at least 50 million tons of ore will be removed in addition to 125 million tons of waste material. Of the 125 million tons of waste, between 10 and 15 million tons is marginal ore that could be economic if the price of gold increases.

The pit will be developed either by conventional drilling and blasting or by using a large bulldozer with a ripper. It is assumed, for this submission, that conventional drilling and blasting techniques are used. Final pit dimensions will be about 3,000 feet in length and 2,000 feet in width with a proposed slope between 45°-55° and with bench heights of about 30 feet.

Soils and subsoils in the pit area will be removed and stockpiled for future reclamation use.

Mining of waste rock and ore from the pit will involve the following types of equipment:

Diesel drills	Haul trucks	Graders
Electric shovels	Bulldozers	Water trucks

6. ORE PROCESSING OPERATION

The ore processing plant includes the following sections:

Crushing	Cyanidation
Grinding	Zinc and Lead concentrate production
Flotation	Dore bullion production

Figure 3 is the process flow sheet. Each major section of the plant is described in this section.

6.1 Crushing

Ore hauled by truck from the open pit will be dumped into a 42-inch gyratory and crushed to a nominal 8-inch size and conveyed through a covered conveyer to a coarse ore stockpile. Suitable dust suppression and/or collection equipment will be employed to minimize airborne dust.

The coarse ore stockpile could contain up to 90,000 tons of ore. As ore is added to the stockpile, an appropriate dust suppressant will be used to control airborne dust.

6.2 Grinding

Due to the soft nature of the ore, additional crushing is not required. The ore will be drawn from feeders below the coarse

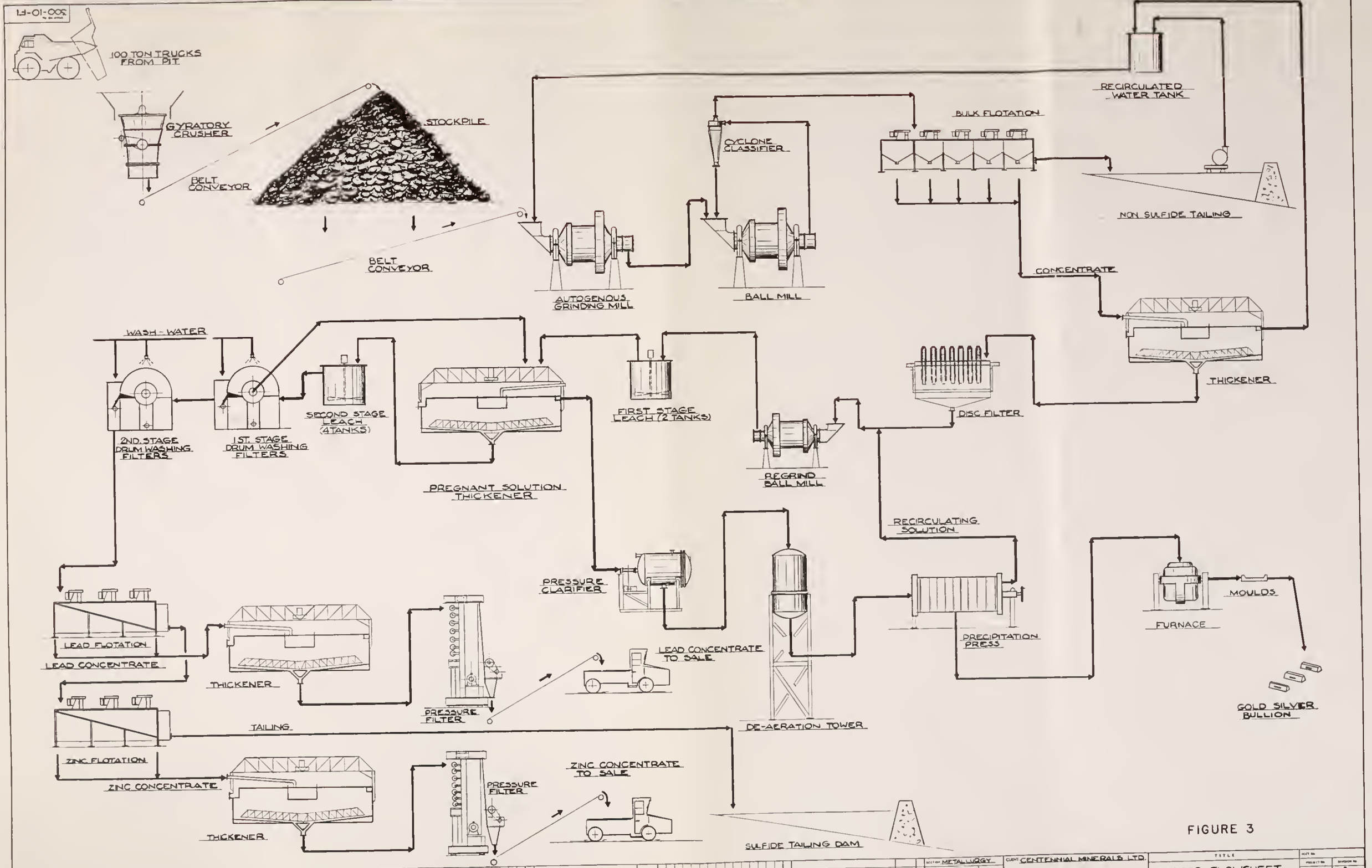

300-10-F1
100 TON TRUCKS FROM PIT
GYRATORY CRUSHER
BELT CONVEYOR
STOCKPILE
BELT CONVEYOR
AUTOGENOUS GRINDING MILL
CYCLONE CLASSIFIER
BALL MILL
BULK FLOTATION
RECIRCULATED WATER TANK
NON SULFIDE TAILING
CONCENTRATE
THICKENER
WASH-WATER
2ND. STAGE DRUM WASHING FILTERS
1ST. STAGE DRUM WASHING FILTERS
SECOND STAGE LEACH (4 TANKS)
PREGNANT SOLUTION THICKENER
FIRST STAGE LEACH (2 TANKS)
REGRIND BALL MILL
DISC FILTER
RECIRCULATING SOLUTION
PRESSURE CLARIFIER
LEAD FLOTATION
LEAD CONCENTRATE
THICKENER
PRESSURE FILTER
LEAD CONCENTRATE TO SALE
DE-AERATION TOWER
PRECIPITATION PRESS
FURNACE
MOULDS
GOLD SILVER BULLION
TAILING
ZINC FLOTATION
ZINC CONCENTRATE
THICKENER
PRESSURE FILTER
ZINC CONCENTRATE TO SALE
SULFIDE TAILING DAM
PRELIMINARY ISSUE FOR COMMENT
METALLURGY
R.M.N.
CENTENNIAL MINERALS LTD.
JEFFERSON CO. MONTANA
KILBORN
PROCESS FLOWSHEET SCHEMATIC
MONTANA TUNNELS PROJECT
7705
15
300-10-F1

FIGURE 3

ore stockpile and fed directly to an autogeneous or a semi-autogeneous grinding mill followed by a ball mill. All grinding will be wet grinding. The ore will be ground to minus 65 mesh.

6.3 Flotation

The ground ore will be pumped to large capacity flotation cells where pyrite, sphalerite, galena, chalcopyrite and precious metals are recovered. Reagents to be used will include lime, a frothing agent, a collector (xanthate), a promoter (Aeroflot 208 or similar) and minor copper sulphate.

Of the 15,000 tons processed per day, about 1000 to 1500 tons (7-10%) will be recovered as concentrate. The remaining 13,500 to 14,000 tons per day of ground material will be transferred to the tailings pond. The ground waste in the tailings pond is expected to be inert material resembling finely ground white sand. Water in the tailings pond will be reused in the process. Reagents used in this process are typical of flotation plants and all decompose or become adsorbed on the freshly ground particle faces. The milling circuit and tailings water will have a basic pH. The ore concentrate will be thickened and pumped to disc filters before being reground in a cyanide solution.

6.4 Cyanidation

Cyanidation will involve using sodium cyanide to dissolve gold and silver from the ore concentrate. Cyanidation will be

conducted in large tanks utilizing a very basic (pH 10 to 11) solution. Following agitation of the concentrate in the tanks with cyanide solution, the remaining solids are thickened, washed and filtered, and the process liquids treated for gold and silver recovery before being recirculated.

6.5 Zinc and Lead Concentrate Production

Following washing and removal of any cyanide solution, the residue consisting primarily of pyrite, lead sulfide and zinc sulfide is run through a flotation process. First, the lead sulfide will be removed, thickened, filtered and shipped to market. Secondly, the zinc sulfide will be removed, thickened, filtered and it, too, will be shipped to market. The market, in this case, would be a lead or zinc smelter perhaps in East Helena, Montana; Trail, British Columbia; or elsewhere.

Tailings from this process, made up primarily of pyrite (iron sulfide) will be pumped to a separate sulfide tailings pond.

6.6 Dore Bullion Production

The cyanide solution containing the gold and silver would be cleaned of solids in a pressure clarifier then mixed with zinc dust to precipitate the gold and silver. The solution will be filtered in a press then recovered and melted and cast into gold/silver bullion.

7. TAILINGS DISPOSAL

Two separate tailings ponds will be constructed. The first will accommodate the coarse tailings (minus 65 mesh) from the bulk flotation circuit. Water decanted from these tailings will be recycled to the mill. The second and much smaller pond will contain finely ground pyrite (98% minus 270 mesh) which has been exposed to a cyanide solution. The pyrite will be well washed before disposal. Excess water from the sulfide tailings pond will be returned to the concentrate leaching process.

8. INFRASTRUCTURE AND POWER SUPPLY

The plant site will include offices, change houses, a wastewater treatment plant, water supply plant, repair shops and other support facilities. It is not anticipated that any permanent housing for personnel will be necessary on the site. Road access would be from Jefferson City with upgrading of the Alta access road to enter the property from the east side. Power is available to the operation from the Montana Power Company's 100 KV transmission lines on the west side of the property. Power would be stepped down to 4160 volts or lower to meet individual plant requirements. It is anticipated that the operation would require 12 megawatts. Natural gas may be required in the operation to replace electrical power at certain stages. The primary water source for the operation has not yet been identified, but a possibility exists that onsite wells will produce sufficient water. Drilling has indicated suitable quality groundwater is present

throughout the fractured orebody. Engineering estimates indicate that makeup water requirements will range from 1,500 to 2,000 gpm.

9. SITE SELECTION

Four alternate site plans showing potential locations for the main project facilities and tailings ponds have been developed (Figures 4, 5, 6 and 7). These plans are preliminary and are for review and discussion. Each alternative site plan shows the final area requirements for tailings and waste rock disposal assuming that a total of 50 million tons of ore and 125 million tons of waste rock are mined. The open pit outline at completion of mining is shown on each plan. A detailed environmental and engineering analysis will be made to evaluate the suitability of each site. Of particular concern will be location of the tailings ponds to avoid any degradation of groundwater or surface water resources. The ponds will be located, designed and constructed utilizing the best practical technology.

10. MANPOWER REQUIREMENTS

During the construction phase, it is estimated that up to 350 persons could be employed at the peak of work. Plant construction will take 6 to 9 months to complete. During operation of the mine, the total work force, including the mining, processing, supervisory and management groups would approximate 200 to 300 persons with an annual payroll of about 10 million dollars.

ACCESS ROAD
PLANTSITE & STOCKPILE AREAS
SULFIDE TAILINGS EL 5525'
BULK FLOTATION TAILINGS EL 5550'
HAUL ROAD
WASTE DUMP EL 5900'
MONTANA TUNNELS MINE
PROPOSED POWER LINE
58,000 E
56,000 E
54,000 E
52,000 E
50,000 E
48,000 E
46,000 E
56,000 N
54,000 N
52,000 N
50,000 N
48,000 N
46,000 N
44,000 N
42,000 N
40,000 N
CENTENNIAL MINERALS LTD
LOCATION JEFFERSON CO. MONTANA
KILBORN
MONTANA TUNNELS PROJECT
PRELIMINARY SITE PLAN EVALUATION
ALTERNATE 1
7705
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REVISIONS

FIGURE 4

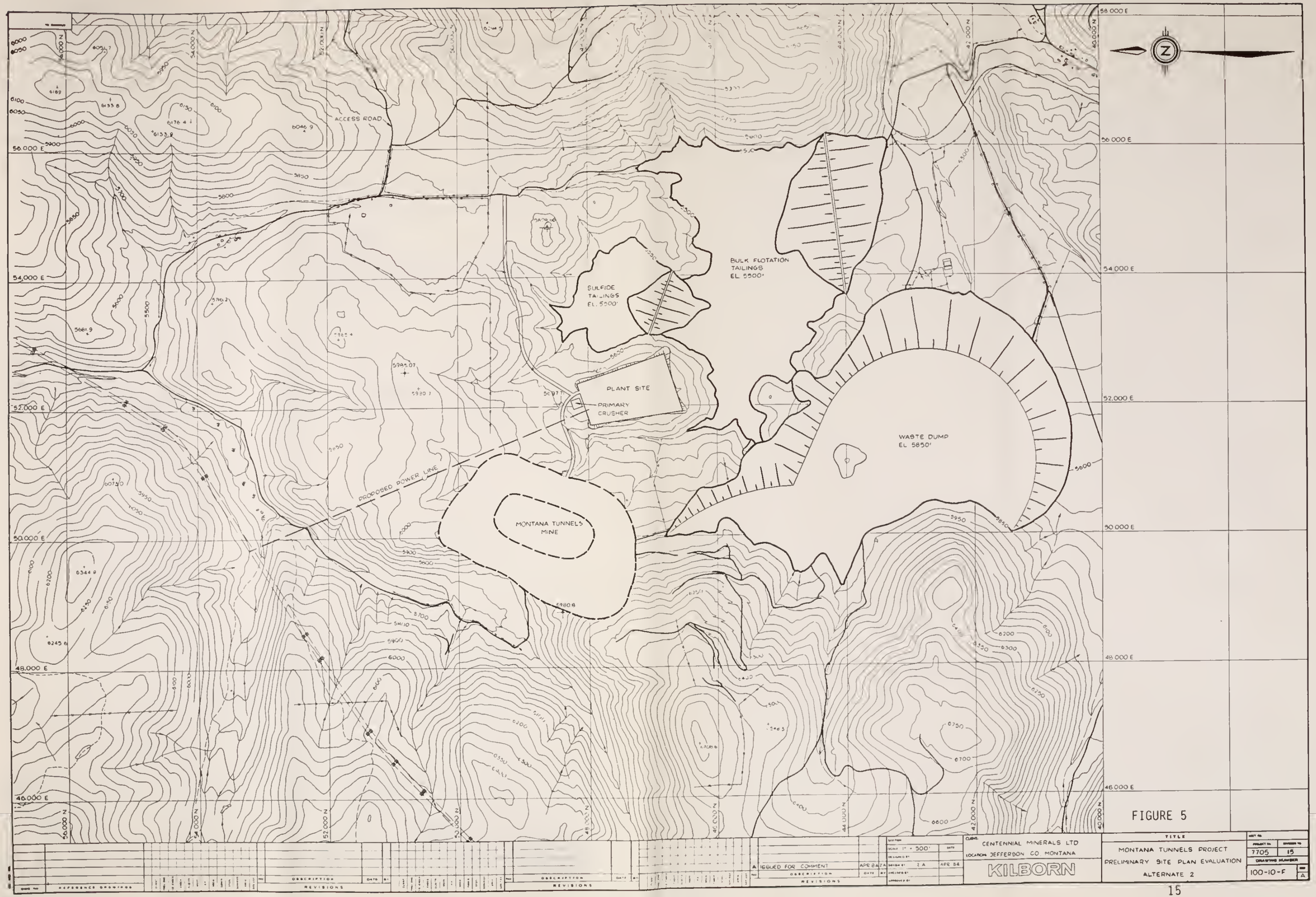
ACCESS ROAD
SULFIDE TAILINGS EL. 5500'
BULK FLOTATION TAILINGS EL. 5500'
PLANT SITE
PRIMARY CRUSHER
WASTE DUMP EL 5850'
PROPOSED POWER LINE
MONTANA TUNNELS MINE
56,000 E
54,000 E
52,000 E
50,000 E
48,000 E
46,000 E
58,000 E
CENTENNIAL MINERALS LTD
LOCATION JEFFERSON CO. MONTANA
KILBORN
ISSUED FOR COMMENT
APR 84
TITLE
MONTANA TUNNELS PROJECT
PRELIMINARY SITE PLAN EVALUATION
ALTERNATE 2
7705
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FIGURE 5

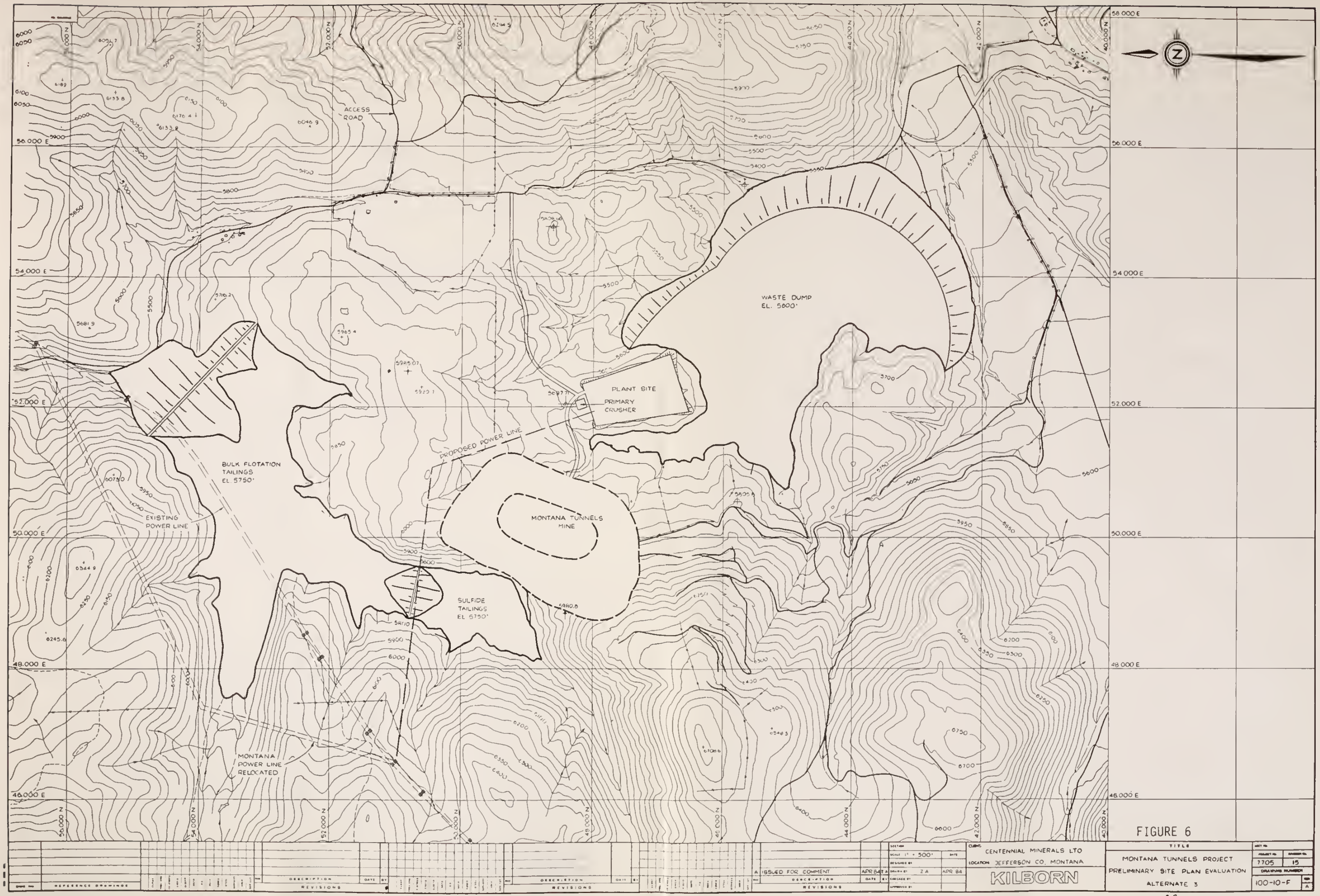
ACCESS ROAD
WASTE DUMP
EL. 5800'
PLANT SITE
PRIMARY CRUSHER
PROPOSED POWER LINE
BULK FLOTATION TAILINGS
EL. 5750'
EXISTING POWER LINE
MONTANA TUNNELS MINE
SULFIDE TAILINGS
EL. 5750'
MONTANA POWER LINE RELOCATED
58,000 E
56,000 E
54,000 E
52,000 E
50,000 E
48,000 E
46,000 E
A ISSUED FOR COMMENT
APR 84
CENTENNIAL MINERALS LTD
JEFFERSON CO. MONTANA
KILBORN
MONTANA TUNNELS PROJECT
PRELIMINARY SITE PLAN EVALUATION
ALTERNATE 3
7705
15
100-10-F

FIGURE 6

ACCESS ROAD
BULK FLOTATION TAILINGS EL 5400'
SULFIDE TAILINGS EL 5500'
PLANT SITE
PRIMARY CRUSHER
WASTE DUMP EL 5900'
PROPOSED POWER LINE
MONTANA TUNNELS MINE
58,000 E
56,000 E
54,000 E
52,000 E
50,000 E
48,000 E
46,000 E
CENTENNIAL MINERALS LTD
LOCATION JEFFERSON CO MONTANA
KILBORN
MONTANA TUNNELS PROJECT
PRELIMINARY SITE PLAN EVALUATION
ALTERNATE 4
7705
15
100-10-F
A
ISSUED FOR COMMENT
APR 84
REVISIONS

FIGURE 7

11. FEDERAL LAND STATUS

Private and federal mineral and surface rights in the general project area are interminingled (Figure 8). Federally administered lands within the Helena National Forest are administered by the U. S. Department of Agriculture - Forest Service (USDA-FS). The remaining federal lands are administered by the U. S. Department of the Interior - Bureau of Land Management (USDI-BLM).

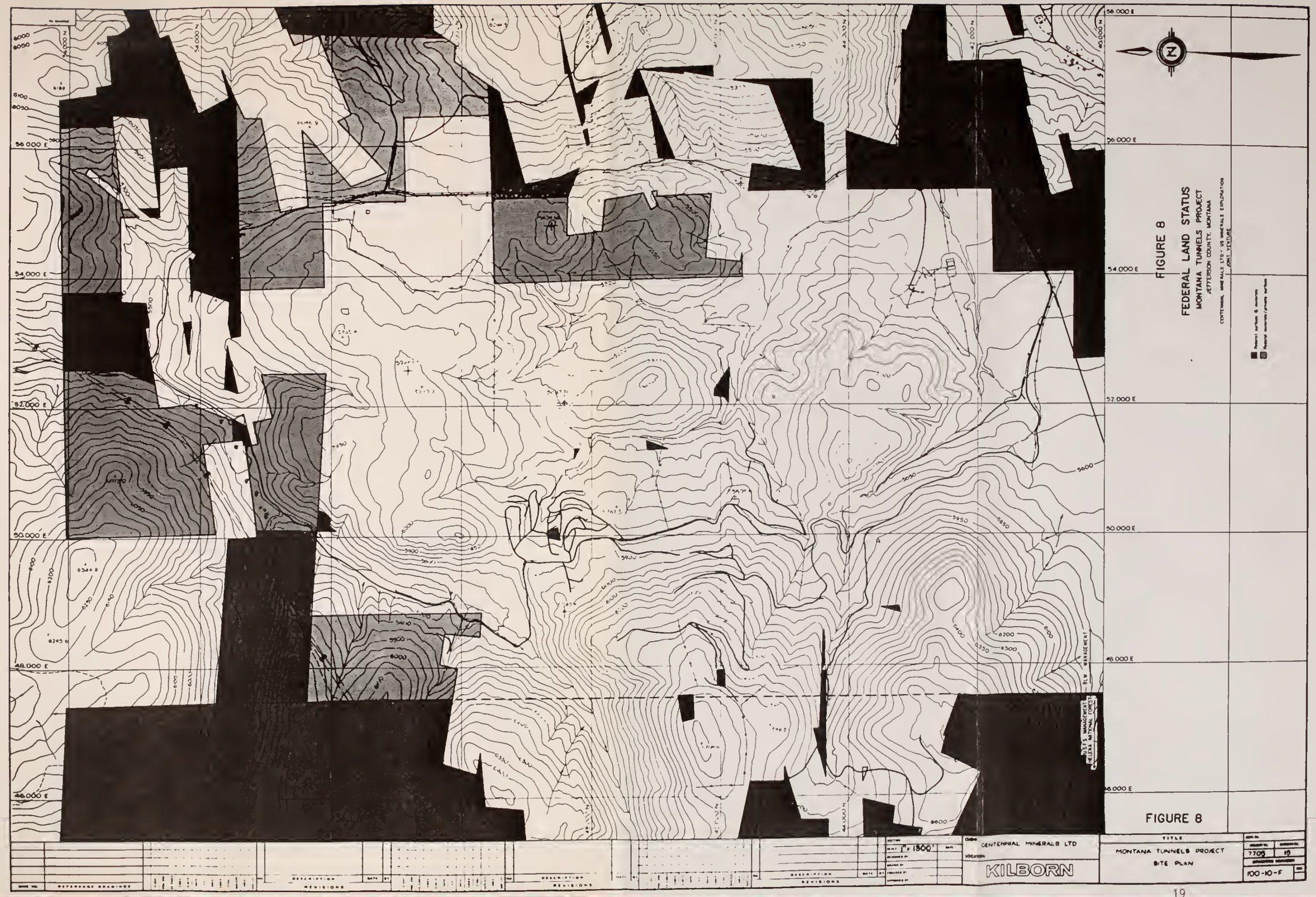
FIGURE 8
FEDERAL LAND STATUS
MONTANA TUNNELS PROJECT
JEFFERSON COUNTY, MONTANA
CENTENNIAL MINERALS LTD - US MINERALS EXPLORATION
JOINT VENTURE
Federal surface & minerals
Federal minerals/private surface
BLM MANAGEMENT
U.S.F.S. MANAGEMENT
HELENA NATIONAL FOREST
56,000 E
54,000 E
52,000 E
50,000 E
48,000 E
46,000 E
N
FIGURE 8
CENTENNIAL MINERALS LTD
KILBORN
MONTANA TUNNELS PROJECT
SITE PLAN
7709
19
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